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ABSTRACT

This course curriculum is intended for use by community college instructors and administrators in implementing a data communications networking course. A student course syllabus provides this information: credit hours, catalog description, prerequisites, required text, instructional process, objectives, student evaluation, and class schedule. A student lecture guide consists of a sheet for each of the 16 units outlining the title, contents, objectives, rationale, learning activities, vocabulary, and evaluation. Unit topics are the development of local area networks (LANs), examining the alternatives, communications and standards, LAN hardware, network operating systems, LAN evaluation, applications software, LAN management, data protection, security, installation, performance, maintenance and diagnostics, internetting, the mainframe connection, and electronic mail. A student lab guide provides this information for each of 12 lab assignments: associated unit, objectives, required materials, learning activities, steps, and handouts. The instructor's course syllabus outlines prerequisites, required texts, references, required equipment and materials, instructional process, and student evaluation. Competency statements and a course outline are included. The instructor's guide presents this information for each unit: contents, objectives, required equipment and materials, procedures, learning activities, evaluation, and answer keys. (YLB)

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ED285024

Curriculum Improvement Project
Region II

DATA COMMUNICATIONS AND NETWORKING

Developed by Diane Easter

U.S. DEPARTMENT OF EDUCATION
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Prepared by:

Galveston College

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PVEP 87-1030-B-2
Project Director: Cheryl L. Willis, Ph.D.

June 30, 1987

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FOREWORD

Galveston College is not unlike other small community colleges trying to keep its curriculum in sight of rapidly changing technologies. We are unique, however, in that we were given an opportunity by the Coordinating Board of the State of Texas through a grant of Carl D. Perkins Act vocational funds to undertake a major curriculum improvement project which had as its focus curricula for accounting, the allied health professions, microcomputer applications, and office occupations. The course curriculum that you have before you is one of nine courses or modules that were developed from this project. What cannot be immediately evident to you, though, is the sense of cooperation that governed the various phases of the project. The resulting benefits to the College, its faculty, and its staff as a result of this project, were many, including increased knowledge of the curriculum improvement process, increased knowledge of the ramifications of networking microcomputers, increased awareness of the vocational programs of other community colleges, and increased awareness of the need for staff development opportunities. The enduring impact of this project will come in the months ahead as our instructors, and hopefully other instructors across Region II and the state, implement the curricula. We at Galveston College are proud of the results of the Curriculum Improvement Project and hope that your college will share the benefits.

Dr. Marc A. Nigliazzo
Vice President and Dean of Instruction
June 30, 1987

REGION II

CURRICULUM IMPROVEMENT PROJECT

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Copies of the above course curriculum are available for a nominal cost from: Division of Business and Technology
Galveston College
4015 Avenue Q
Galveston, TX 77550

A C K N O W L E D G M E N T S

This course curriculum represents but one of the many final products of the Curriculum Improvement Project. I want to take this opportunity to thank those individuals who worked so hard together to bring this project to a successful conclusion. To the administration and the Board of Regents of Galveston College I wish to express my appreciation for their willingness to accept the challenges and risks associated with a project of this magnitude and for having the forethought to see its benefits for the college and the community. To the support staff in the Business Office and the Office of Planning and Development, thank you for your patience and helpfulness in providing the project staff with everything we needed--yesterday. To Karla Back, Assistant Dean of the Division of Business and Technology, for her constant encouragement of the vision of the project, I will be forever grateful. My most heartfelt thanks, though, go to the project team--all of the curriculum writers who gave 110 percent effort whenever it was needed; the various editors and word processors who helped us along the way; Paul Fama, Research Associate, who provided constancy and consistency; and Mary James, project secretary, who kept us all sane.

Galveston, Texas
June 30, 1987

Cheryl L. Willis, Ph.D.
Project Director

P R E F A C E

The following course curriculum should be used as a resource by fellow instructors and administrators when making decisions about implementing a similar course at their institutions. This course curriculum contains five parts--student's course syllabus, student's lecture guides and student's laboratory guides for each unit of the course, instructor's course syllabus, and instructor's guides for each unit of the course. The materials presented in this course curriculum are only a suggested format for a course of this nature and, as typical with community college curriculum, will undergo revision in the future. The author and Galveston College welcome your comments regarding your experience with these materials.

STUDENT COURSE SYLLABUS

CST 2408: Data Communications and Networking

STUDENT'S COURSE SYLLABUS

Course Title: DATA COMMUNICATIONS AND NETWORKING

Course Number:

CST	2408	3	2	4
Prefix	No.	Lecture Hrs.	Lab Hrs.	Credit Hrs.

Catalog Description:

An introduction to networking techniques, systems, and problems. Topics include interfacing techniques, common peripherals, compatibility, and network design and modeling.

Prerequisite:

CSC 1301--Introductory Computing
CSC 1305--Logic and Theory
CST 2403--Fundamentals of Hardware

Co-Requisite:

CST 2401--Operating Systems

Text: Networking IBM PC's, 2nd edition, by Michael Durr, QueCorp, 1987.

Instructional Process:

1. Lecture, discussion, and demonstration. Student's Lecture Guides provide outlines of lecture content, objectives, and requirements for each unit. Students are to write definitions for vocabulary words provided in Student's Lecture Guides.

2. Laboratory assignments will be distributed each week. The assignments can be found in the Student Lab materials. Student's Laboratory Guides provide outlines of laboratory assignments, equipment and materials needed, and steps to follow in completing lab assignments.

3. Test and quizzes will be given periodically.

4. Homework will be assigned as necessary.

Objectives: Upon completion of this course, the student will be able to:

1. acquire an understanding of the concepts of networking microcomputer systems together.

2. gain a understanding of the problems which might occur with a networked microcomputer system.

3. learn interfacing techniques and common peripherals used in networking microcomputer systems.

4. explore compatibilities and network design of microcomputer systems.

Evaluation of Students:

Examinations: Three unit exams and a final exam will be given during the semester. NO MAKE-UP EXAMS SHALL BE GIVEN WITHOUT PRIOR APPROVAL.

Quizzes: Quizzes will be administered periodically throughout the semester. The quiz will be similar to exam questions. NO MAKE-UP QUIZZES WILL BE GIVEN REGARDLESS OF REASON FOR ABSENCE.

Laboratory/Homework: Assignments will generally be due at the end of the week. Late assignments will be accepted for one week after the due date with a 20% reduction in grade. After one week assignments will not be accepted.

Final Grade Determination:

Grades for the semester will be determined based on the accumulated points earned. To determine a tentative grade, divide the total points earned by the total possible points. The grading scale will be strictly 90, 80, 70, 60 percent of the possible points.

Approximately 40% of the total points will be from lab assignments and homework, 40% from tests and quizzes, and 20% from the final exam.

Class Schedule:

Week No.	Description	Due	Assignment
1	The Growth of Office Automation The Local Area Network Defined LANs in Action	Quiz 1	Chapter 1 Lab. 1
2	Why Connect to a Network? How Is a LAN Structured?	Lab. 2	Chapter 2 Lab. 2
3	The OSI Model Standards--software, server DOS Multiuser Support	Quiz 2 Lab. 3	Chapter 3 Lab. 3
4	Cable Alternatives, Schemes LAN Topologies Network Interface Cards Network Configurations Servers Alternatives	Test 1 Lab. 4	Chapter 4 Lab. 4
5	Network Utilities The File Server LAN Programs	Lab. 5	Chapter 5 Lab. 5
6	The Physical Site, Functions Evaluating NICs, Servers, OS's The Performance Formula	Quiz 3	Chapter 6 Lab.6
7	Hard Disk Compatibility Licensing Single-User, Multiuser Approach Software, Programming	Lab. 6	Chapter 7
8	Choosing the Supervisor Mapping Out the Network Organizing Files, Users, Directories	Test 2 Lab. 7	Chapter 8 Lab. 7
9	Backups--Streaming, File-File Correcting Errors Software Considerations Making Your System Fault Tolerant	Lab. 8	Chapter 9 Lab. 8
10	Networks and Security Risk Analysis Levels of Security	Quiz 4	Chapter 10 Lab. 9
11	The Installation Log Cable Considerations Fault Tolerance, Grounding	Lab. 9	Chapter 11

Week No.	Description	Due	Assignment
12	The Data Path Network Servers: How Many To Use?	Test 3 Lab.10	Chapter 12 Lab. 10
13	Network Control Center Diagnostics--LAN, Hardware The Role of the Network Manager Network Monitoring		Chapter 13 Lab. 11
14	Internet Hardware Remote Interconnection Asynchronous Gateways, Modem Pools	Quiz 5 Lab.11	Chapter 14
15	Evaluation--Terminal, Emulator How To Evaluate an Emulator The Emulator on the Network Mainframe Gateways		Chapter 15 Lab. 12
16	Electronic Mail An Intraoffice Study Interoffice Mail	Lab.12	Chapter 16
17	Final Exam.--(50% from Chapters 1-12, 50% from Chapters 13-16)		

STUDENT LECTURE GUIDE

CST 2408: Data Communications and Networking

STUDENT'S GUIDE (LECTURE)

Unit 1

Unit Title: The Development of LANs

Contents of Unit:

1. The Growth of Office Automation

2. The Local Area Network Defined

   a. Components of the Network

      1. Cable
      2. Network Interface Card
      3. Network Servers
      4. Central Mass Storage
      5. Workstations

   b. The Development of Network Applications
   c. The Network as a Communications System

3. LANs in Action

Unit Objectives: Upon completion of this unit, the student will be able to:

1. Describe the growth of office automation.
2. Define what constitutes a local area network.
3. Describe the parts of a LAN.

Rationale: Students must be able to define and understand the development of LANs before they can fully grasp the need and uses of LANs.

Learning Activities: Read Chapter 1

Unit Evaluation: Quiz #1

Terms (vocabulary):

network adapter	applications	cable
central mass storage	file server	server
communications system	constellation	database management system
file locking	record	record locking
network interface card	shareable	Local Area Network(LAN)
multiplexer device	workstation	shareable, read/write
non-shareable	network	shareable, read-only
host processor	distributed database	

CST 2408: Data Communications and Networking

STUDENT'S GUIDE (Lecture)

Unit 2

Unit Title: Examining the Alternatives

Unit Objectives: Upon completion of this unit, the student will be able to:

1. Define and describe a resource management situation.
2. Describe networking alternatives.
3. Describe the difference between a LAN and PBX or shared-processor system.
4. Describe the conditions needed for LAN to be the best solution.

Contents of Unit:

1. Why Connect to a Network?
   a. Resource Management
   b. PCs in a Host System
   c. Networking Alternatives
2. How Is a LAN Structured?

Rationale: The student must learn the options available for interconnectivity before an informed purchase can be made.

Learning Activities: Read Chapter 2

Unit Evaluation: None

Terms (vocabulary):

architecture	distributed functions	shared functions
response time	organizational benefits	sharing software
sharing information	PBX to LAN connections	processors
hardware add-ons	networking alternatives	host systems
resource management	Public Branch Exchange(PBX)	
peripherals		

CST 2408: Data Communications and Networking

STUDENT'S GUIDE (LECTURE)

Unit 3

Unit Title: Communications and Standards

Unit Objective: Upon completion of this unit, the student will be able to:

1. List in order the seven layers of the International Organization Standard's Open System Interconnection (OSI) model.
2. Describe each of the seven layers of OSI including interconnectivity between levels.
3. Describe the software standards for:

    a. The subnet
    b. Presentation layers
    c. File servers

4. Define DOS Multiuser support.

Contents of Unit:

1. The OSI Model

    a. Layer 1: Physical
    b. Layer 2: Data-Link
    c. Layer 3: Network
    d. Layer 4: Transport
    e. Layer 5: Session
    f. Layer 6: Presentation
    g. Layer 7: Application

2. Software Standards-the Subnet

3. The LAN File Server Standard

4. Software Standards-the Presentation Layer

5. DOS Multiuser Support

Rationale: Students must know the levels at which communication can occur before the need at a specific installation can be determined.

Learning Activities: Read Chapter 3

Unit Evaluation: Quiz #2 (Chapters 2-3)

Terms (vocabulary):

network operating system
component interchangeability
Manufacturing Automation
International Organization for Standardization (ISO)
Network Basic Input and Output System
Open System Interconnection
software standards
Technical and Office Protocol
virtual connection
physical connection
network management
transparent internetwork
file locking
application-to-network interface
7 Layers:
- Physical
- Data-link
- Network
- Transport
- Session
- Presentation
- Application

ARCnet
disk server
Logical Unit
Protocol(MAP)
multiuser support
access Control
physical lock
redirector
switching
Token-Bus
hardware standard
network addressing
network applications
hardware layers
gateways

bandwidth
extended open formats
Omninet
NETBIOS
shell
OSI Model
subnet level
Token-Ring
Top
packets
topology
routing
translation
file server

CST 2408: Data Communications and Networking

STUDENT'S GUIDE (LECTURE)

Unit 4

Unit Title: LAN Hardware

Unit Objectives: Upon completion of this unit, the student will be able to:

1. Describe cabling schemes and alternatives.
2. Describe at least 3 LAN topologies including specfic product examples.
3. List the pros and cons of at least 3 network interface cards.
4. List the pros and cons of at least 3 network servers.
5. Choose the appropriate hardware and topology for any specific case study.

Contents of Unit:

1. Cable Alternatives
2. LAN Topologies
3. Cable Access Schemes
4. Network Interface Cards
   a. Ethernet
   b. AT&T Starlan
   c. Corvus Omninet
   d. Gateway Communications' G-Net
   e. IBM PC Cluster
   f. IBM PC Network
   g. Orchid PC Net
   h. 3COM EtherLink
   i. Ungermann-Bass Net/One Personal Connection
5. Token Bus Networks
   a. Allen-Bradley VistaLAN/PC
   b. Nestar Plan Series
6. Token-Ring Networks
   a. IBM Token-Ring
   b. Proteon ProNET
7. Star Networks
   a. Novell S-Net
8. Network Servers

9. Servers Alternatives

   a. IBM PC XT
   b. IBM PC AT
   c. Nestar Plan 5000
   d. Novell S-Net Server
   e. Novell 286A/B
   f. 3Com 3Server

Rationale: Cabling and LAN hardware architectures are an integral part of the decisions made when installing a LAN.

Learning Activities: Read Chapter 4

Unit Evaluation: Test #1 (Chapters 1-4)

Terms (vocabulary):

3Com 3Server	3Com EtherLink	80386 microcomputers
3Com	collision avoidance	collision detection
contention	token	Allen-Bradley
AT&T Starlan	coaxial cable	baseband coaxial (coax)
fiber-optic	twisted pair	broadband coaxial (coax)
EtherNet	EtherLink+	Corvus Omninet
G-Net	IBM PC AT	Gateway Communications
IBM PC XT	IBM PC Network	IBM PC Cluster
NetWare	interface card	Nestar Plan 5000
NICs	Novell 286A/B	Nestar Plan Series
ProNET	Novell S-Net	
Net/One Personal	Connection	Proteon
Orchid PC Net	Novell S-Net Server	servers
star network	Token-Bus	Token-Ring
topology	distributed star	hub
linear bus	Ungermann-Bass	star
star-wired ring	tree topology	VistaLAN/PC
LAN hardware	token passing	packets
baseband transmission		broadband transmission
bus or trunk	network servers	

CST 2408: Data Communications and Networking

STUDENT'S GUIDE (LECTURE)

Unit 5

Unit Title: Network Operating Systems

Unit Objectives: Upon completion of this unit, the student will be able to:

1. Define the responsibilites of a network operating system.
2. Describe the installation procedure for at least 3 network operating systems.
3. Describe the commands needed to use at least 3 network operating systems.

Contents of Unit:

1. Network Utilities
2. The File Server
3. IBM PC Local Area Network Program
   a. Installing PCLANP
   b. PCLANP Commands
   c. Using PCLANP
4. 3Com 3+
   a. Installing 3+
   b. 3+ Commands
   c. Using the 3+ Network
5. Novell Advanced NetWare
   a. Installing NetWare
   b. NetWare Commands
   c. Using the NetWare Network

Rationale: Understanding the types and abilities of intranetwork communications is vital to developing network configurations.

Learning Activities: Read Chapter 5

Unit Evaluation: None

Terms (vocabulary):

3Com 3+
IBM PCLANP
multitasking
public directory
private directory
printer buffer
session
menu
queue
map
sharenames
locking
multiuser
PCLANP
utility
file server
filer
queue
logout
directory specification
login
NetWare
nonshareable directory
Novell Advanced NetWare
shareable directory
syscon
supervisor
user profile

CST 2408: Data Communications and Networking

STUDENT'S GUIDE (LECTURE)

Unit 6

Unit Title: LAN Evaluation

Unit Objectives: Upon completion of this unit, the student will be able to:

1. List at least 3 reasons the physical site must be described in detail before selecting networking equipment
2. Define the functions of a local area network.
3. List the four characteristics of a network interface card (NIC).
4. Define the criteria used to describe network servers.
5. Define the criteria used to evaluate network operating systems.
6. Estimate hardware throughput performance.
7. Estimate system throughput performance.

Contents of Unit:

1. The Physical Site
2. Network Functions
3. Evaluating NICs
4. Evaluating Servers
5. Evaluting Operating Systems
6. Estimating Hardware Performance
7. The Performance Formula
8. New Products

Rationale: To choose the best network for an installation, students must understand the criteria for evaluation.

Learning Activities: Read Chapter 6

Unit Evaluation: Quiz #3 (Chapters 5-6)

Terms (vocabulary):

bit rate
bus width
cache
clock crystal
clock cycle speed
expansion bus
interface card
memory maximum
network evaluation
hardware performance
network functions
NICs
operating systems
performance formula
physical site
maximum network throughput
servers
processor speed
cable access scheme
processor
wait state
onboard processor
cost
functionality
NIC-to-host transfer method
per-station
system security
minimum single-station throughput

CST 2408: Data Communications and Networking

STUDENT'S GUIDE (LECTURE)

Unit 7

Unit Title: Applications Software

Unit Objectives: Upon completion of this unit, the student will be able to:

1. Describe hard disk compatibility problems.
2. Define the difference between site and single user licenses.
3. Describe the precautions that must be included in programs that are used in a networking environment.

Contents of Unit:

1. Hard Disk Compatibility
2. Site Licensing
3. Single-User Applications
4. A Multiuser Approach
5. Smart Single-User Software
6. Programming on the Net

Rationale: The availability and problems associated with using applications software on a networked system is both a necessary part of all systems and usually complex.

Learning Activities: Read Chapter 7

Unit Evaluation: None

Terms (vocabulary):

applications software	multiuser	multiuser approach
multiuser software	sharing	network programming
copy-protected diskette	database	compatibility
multiprocessing	single-user	site licensing
transaction processing	DBMS	

CST 2408: Data Communications and Networking

STUDENT'S GUIDE (LECTURE)

Unit 8

Unit Title: LAN Management

Unit Objectives: Upon completion of this unit, the student will be able to:

1. Know the steps in mapping out a network.
2. Describe the reasons files must be organized according to owners, users and privileges.
3. Describe common standards for setting up and naming files.
4. List criteria used to determine if a file should be network accessable.

Contents of Unit:

1. Choosing the Network Supervisor
2. Mapping Out the Network: The Initial Planning
3. Organizing Files
4. Assigning Users
5. Setting Up Directories
6. Determing What Files Go on the Network
7. Using Decriptive Names To Identify Files
8. Using the Front-End Approach.

Rationale: To create an efficient organization using a network, guidelines must be designed and standardized.

Learning Activities: Read Chapter 8

Unit Evaluation: Test #2 (Chapters 5-8)

Terms (vocabulary):

organizing files, setting up directories, network, supervisor, initial planning, front-end, approach, network management, naming, files, assigning users, determining files on the network

CST 2408: Data Communications and Networking

STUDENT'S GUIDE (LECTURE)

Unit 9

Unit Title: Data Protection

Unit Objectives: Upon completion of this unit, the student will be able to:

1. Describe the need for data protection.
2. List at least 3 common backup devices.
3. Describe the criteria for selecting a specific tape system.
4. Define both a hard and soft error.
5. Describe the advantages and disadvantages of streaming and file-by-file backup systems.
6. Describe the process and reasons for archiving files.

Contents of Unit:

1. Using Backup Devices
2. Selecting a Tape System
3. Correcting Errors
4. Software Considerations
5. Two Tape Backup Systems: Streaming and File-by-File
6. Performing the Backup Operation
7. Making Your System Fault Tolerant
8. Saving Hard Disk Space by Archiving Files

Rationale: Networking creates unique file protection and data control problems. Both on-line and backup procedures must be considered before a network can be fully utilized.

Learning Activities: Read Chapter 9

Unit Evaluation: None

Terms (vocabulary):

archive server
backup devices
data protection
disk duplexing
disk mirroring
edge seek
exclusive OR
file-by-file backup
hard error
start-stop
steaming
tape server
tape system backup
correcting errors
soft error
transaction tracking
automatic gain adjustment
fault tolerant
file-by-file
read-after-write-verification
archiving
automatic retensioning capability
servo track

CST 2408: Data Communications and Networking

STUDENT'S GUIDE (LECTURE)

Unit 10

Unit Title: Security

Unit Objectives: Upon completion of this unit, the student will be able to:

1. Describe the necessity for network security.
2. List the levels of network security.
3. Describe three short case studies that demonstrates the need for at least 3 of the network security levels.

Contents of Unit:

1. Networks and Security
2. Risk Analysis
3. Levels of Security

    a. Physical Security
    b. Personal Identification
    c. Passwords
    d. Security in Login
    e. Encryption

        1. Encryption Keys
        2. On-Line Coders

    f. The Diskless PC
    g. Protection against Cable Radiation
    h. Call-Back Security

Rationale: Both mainframes and microcomputers have security built into the systems. When networking between systems, an additional security problem is introduced. This problem must be addressed before the network can be used.

Learning Activities: Read Chapter 10

Unit Evaluation: Quiz #4 (Chapters 9-10)

Terms (vocabulary):

Radiation	call-back security	
Data Encryption Standard(DES)		diskless PC
encryption	encryption keys	login security
on-line coders	passwords	security
physical security	risk analysis	key
decryption	personal identification	

CST 2408: Data Communications and Networking

STUDENT'S GUIDE (LECTURE)

Unit 11

Unit Title: Installation

Unit Objectives: Upon completion of this unit, the student will be able to:

1. Describe the reasons an installation log is necessary.
2. List 4 methods of distributing cable, including modeling examples.
3. List 4 reasons planning ahead is necessary.
4. Name 3 problems associated with cable installation.
5. Describe types of cable, cable connectors, and grounding techniques.
6. Describe cable testing and tolerance levels.
7. List 6 sources of interference and include methods to overcome the problem.

Contents of Unit:

1. The Installation Log
2. Cable Distribution
3. Planning Ahead
4. Cable Handling
5. Cable Connectors
6. Fire-Retardant Cable
7. Cable Testing
8. Fault Tolerance
9. Interference
10. Grounding

Rationale: Before a network can be installed, installation procedures must be learned and understood.

Learning Activities: Read Chapter 11

Unit Evaluation: None

Terms (vocabulary):

Cable Connectors	cable distribution	fire-retardant
cable handling	cable testing	fault tolerence
grounding	interference	network installation
log		

CST 2408: Data Communications and Networking

STUDENT'S GUIDE (LECTURE)

Unit 12

Unit Title: Performance

Unit Objectives: Upon completion of this unit, the student will be able to:

1. List 2 methods to increase performance.
2. Define and give an example of a hierarchical directory.
3. Describe the methods used to determine how many servers should be used.
4. Describe reasons for channel and cable bottlenecks.

Contents of Unit:

1. The Data Path
   a. Using Disk Caching To Speed Up Network Operation
   b. Improving Access Time by Organizing Files
2. Network Servers: How Many To Use?
   a. Solving Disk Channel Problems
   b. Avoiding Cable Bottlenecks
3. Conclusion

Rationale: In order to improve upon network performances, the process of evaluating performance and performance solutions must be understood.

Learning Activities: Read Chapter 12

Unit Evaluation: Test #3 (Chapters 9-12)

Terms (vocabulary):

Access time	cable bottlenecks	caching
data path	disk channel problems	servers
organizing files	hierarchical directories	disk caching
seek access time	bridge	

CST 2408: Data Communications and Networking

STUDENT'S GUIDE (LECTURE)

Unit 13

Unit Title: Maintenance and Diagnostics

Unit Objectives: Upon completion of this unit, the student will be able to:

1. Execute a network diagnostics program for the software.
2. Execute a network diagnostics program for the hardware.
3. Describe the role of the network manager.

Contents of Unit:

1. Network Control Center
2. Local Area Network diagnostics
3. NetWare Diagnostics
4. Diagnostics in Hardware
5. The role of the Network Manager
6. Network Monitoring
7. Looking Ahead

Rationale: In order to maintain a network and fix any problems that may occur, diagnostics must be understood.

Learning Activities: Read Chapter 13

Unit Evaluation: None

Terms (vocabulary):

hardware diagnostics
Audit trail
NetWare diagnostics
network performance diagnostics
Network Control Center (NCC)

CST 2408: Data Communications and Networking

STUDENT'S GUIDE (LECTURE)

Unit 14

Unit Title: Internetting

Unit Objectives: Upon completion of this unit, the student will be able to:

1. Produce an example of internetting.
2. List 3 reasons internetting is useful or necessary.
3. Describe the levels at which internetting can occur.
4. List 2 protocols used for remote interconnecting and describe when each should be used.

Contents of Unit:

1. Internet Hardware
2. Remote Interconnection
3. Asynchronous Gateways and Modem Pools
4. X.25 for Wide Areas
5. X.25 Options
6. Conclusion

Rationale: A majority of installations will have more than one network. To connect one network to another (internetting) additional hardware, software and schema must be implemented.

Learning Activities: Read Chapter 14

Unit Evaluation: Quiz #5 (Chapters 13-14)

Terms (vocabulary):

Consultative Committee for International Telegraph and Telephone (CCITT)

bottom-up approach	bridge	clustered networks
asynchronous	modem	modem pool
internetting hardware	LAN-to-remote	remote interconnection
remote login	repeater	router
screen transfer	Telenet	top-down approach
wide area network	X.25 networks	Tymnet
backbone		

CST 2408: Data Communications and Networking

STUDENT'S GUIDE (LECTURE)

Unit 15

Unit Title: The Mainframe Connection

Unit Objectives: Upon completion of this unit, the student will be able to:

1. Describe 3 common pitfalls when networking microcomputers with mainframes.
2. Describe the methods used to evaluate emulators.
3. List and describe 2 mainframe gateways.
4. List the advantages and disadvantages of using a PC for backup procedures.

Contents of Unit:

1. Terminal Evaluation
2. How To Evaluate an Emulator
3. The Emulator on the Network
4. Mainframe Gateways: Alternatives to Terminal Emulation
5. PCs as Mainframe Workstations
6. Backup on the PC
7. Downtime Equals Loss

Rationale: Many installations will connect one or more networks to a mainframe computer. To understand the interconnectivity, many considerations must be examined.

Learning Activities: Read Chapter 15

Unit Evaluation: None

Terms (vocabulary):

3270 terminal	3278 Model 2	3278 Model 3
3278 Model 4	3729 terminal	CXI
DCA	DEC VT100 terminal	emulation
gateway	mainframe	IBM
terminal emulator	IBM 308X	IBM 43XX
IBM 3101 terminal	IBM System/370	
Pathway Design backup package evaluating an emulator	mainframe workstations	

CST 2408: Data Communications and Networking

STUDENT'S GUIDE (LECTURE)

Unit 16

Unit Title: Electronic Mail

Unit Objectives: Upon completion of this unit, the student will be able to:

1. Define electronic mail.
2. List the components in electronic mail packages.
3. Evaluate electronic mail packages for capabilities and efficiency.
4. Describe the difference between interoffice and intraoffice mail.

Contents of Unit:

1. Defining Electronic Mail
2. Using Electronic Mail
3. Evaluating Electronic Mail
4. An Intraoffice Study
5. Interoffice Mail

Rationale: One of the advantages of networked PC's over stand-alone PC's is the ability to send messages between computers. Understanding the types and uses of electronic mail will increase productivity when implemented efficiently.

Learning Activities: Read Chapter 16

Unit Evaluation: None

Terms (vocabulary):

CCITT X.400 protocol	Computer-Based Message System(CBMS)	
DISOSS	electronic mail	evaluting
interoffic	intraoffice	using
critical mass		

STUDENT LAB GUIDE

CST 2408: Data Communications and Networking

STUDENT'S GUIDE (LABORATORY)

Lab Assignment #1

Unit Title: Facilities Tour

Assignment Is Associated With: The Development of LANs (Chapter 1)

Time Required: 2 hours

Objectives: Upon completion of this lab, the student will be able to:

1. Discuss the similarities and differences in facilities at the institution.
2. List all computer related working environments available at the institution and categorize them as stand-alone, networked or shared environments.
3. Compare and contrast the computer environments.
4. List 4 differences in hardware between environments.

Materials Required:

Networked PC lab
Access to all computer areas for a tour

Laboratory Handouts: None

Learning Activities (assignments): Participate in the tour.

Steps:

1. Tour facilities, included in the tour are:

    a. Computer room(s) for mainframe

        1. Terminals
        2. Cables To Terminals And Other Devices
        3. Backup Systems
        4. Secondary Storage
        5. Virtual Storage Devices

b. Computer room(s) for PC without network

1. PC's
2. Cabling
3. Backup Systems (where available)
4. Secondary Storage (where available)
5. Virtual Storage Devices (where available)

c. Computer room(s) for PC with network

1. Cabling For Network
2. Circuitry For Network
3. Additional Storage Devices Helpful Or Needed Due To Networking

2. Discussion questions upon return from tour:

a. What are the differences between a mainframe system and a stand-alone PC?
b. What are the similarities between a mainframe system and a stand-alone PC?
c. How does the network of PC's emulate a mainframe?
d. How does the network of PC's differ from a mainframe?

CST 2408: Data Communications and Networking

STUDENT'S GUIDE (LABORATORY)

Lab Assignment #2

Unit Title: Setting up the hardware needs for EasyLAN.

Assignment Is Associated With: Examining the Alternatives (Chapter 2)

Time Required: 2 hours

Objectives: Upon completion of this lab, the student will be able to:

1. List the supplies and equipment needed to install the necessary hardware for EasyLAN.
2. List the pin configuration on a RS232 and define the specific pins used in installation.
3. Describe the color code standards for wiring.

Equipment and Materials Required:

Stand-alone PC's (2 for each group)
15 feet of cable per group
2 RS232 connectors per group
Solder (one roll, distribute as needed)
Soldering iron (1 for every 1 to 2 groups)
Wire strippers (1 for every 1 to 2 groups)
Pliers (1 for every 1 to 2 groups)
Volt meter

Laboratory Handouts:

Care and Use of Soldering Irons (attached)
RS-232 Connector Pin Configurations (attached)

Learning Activities (assignments): Complete Lab 2

Steps:

1. Describe the overall assignment

   a. to install the hardware necessary to have two PC's networked together using EasyLAN.
   b. Describe relativity of Send-receive, source-target or transmit-receive
   c. Describe 0's and 1's, mark or spaces, and + or - voltage.
   d. work in partners (Class size and equipment may require groups of 3 or 4. No more than 4 per group is effective.)

2. Describe the:

   a. solder uses and care handout
   b. connector pin configurations
   c. wires

      1. color coding standards
      2. wires that cross over
      3. amount of wire to strip

   d. cautions when pins are usually bent

3. Complete the steps:

   a. Strip and solder the wires to the connectors.
   b. Connect the completed cables to the PC's.
   c. Have the instructor check the cable. After receiving a grade, label each with the group number.
   d. Disconnect and place the cable in storage for the next class.

Care and Use of Soldering Irons

Soldering is a metal-joining process in which a lower melting-point metal (called solder) is heated to the point where it melts and wets the joint surface and then is allowed to solidify in place. Copper, tin, lead, and brass are examples of readily solderable metals. Galvanized iron, stainless steel, and aluminum are difficult to solder.

Soldering is a practical method of forming reliable electrical connections where bare wires are twisted together or are wound on terminals. Soldered joints, however, do not support loads for long periods of time as well as welded joints do. In soldering the readily solderable metals, you only need the solder, a flux, and a heat source.

Solders, by definition, are joining materials or alloys that melt below 800 degrees F. Solders used for electrical connections are alloys of tin and lead whose melting points range between 360 and 465 degrees F (both endpoints are approximate).

Soldering fluxes are agents which clean solderable medals by removing the oxide film normally present on the metals and also prevent further oxidation. Fluxes are classified as noncorrosive, mildly corrosive, or corrosive, ranging from mild substances such as rosin to chemically active salts such as zinc chloride. Because of their corrosive effects, so-called acid core solders (which incorporate salt-type fluxes) must NOT be used in soldering electrical connections.

Soldering Procedures

1. If a soldering iron is new or has just been forced, it will need to be tinned (coated with solder). Sometimes the point needs to be filed.

2. The parts to be soldered must be absolutely clean (free from oxide, corrosion and grease).

3. The joint should be prepared just prior to soldering since the prepared surfaces will soon corrode or become dirty.

4. The parts to be joined must be securely joined mechanically before any soldering is done.

5. To solder electrical connections, hold the soldering iron (copper) beneath the splice being soldered with as much mechanical contact as possible to permit maximum heat transfer.

Care and Use of Soldering Irons

6. Apply the rosin core solder to the splice. The tinning on the soldering iron aids the transfer of heat to the spliced wire which, when hot enough, will melt the solder. Before this temperature is reached the rosin core will have melted and run out over the wire to flux the splice.

7. When the solder has coated the splice completely, the job is finished. No extra solder is needed. A good, well-bonded connection is clean, shiny, smooth and round.

Precautions

1. Soldering irons must not remain connected longer than necessary.

2. Keep irons away from flammable material.

3. Always assume that a soldering iron is hot (to avoid burns).

4. Only rest the heated iron on the rack provided for this purpose.

5. Never swing an iron to remove solder. The bits of solder that come off may cause serious skin or eye burns.

6. Always clean the iron with a damp sponge or cleaning cloth. DO NOT hold the cloth or sponge in your hand. Always place the cloth or sponge on a suitable surface and wipe the iron across it to prevent burning your hand.

7. Hold small soldering jobs with your pliers or a suitable clamping device. Never hold the work in your hand.

8. After the iron is disconnected and cooled, stow it in its assigned area. Do not throw irons into a toolbox.

9. When storing irons for long periods of time, coat the shaft and all metal parts with rust-preventive compound and store in a dry place.

Information compiled from: Tools and Their Uses,
By: U.S. Navy Bureau of Naval Personnel, Dover Publishing Company, 1973.

RS-232 Connector Pin Configurations

The following is a summary of the ANSI standard RS-232 pin configuration. Most serial interconnections of terminals, modems, printers and personal computers use the RS-232 connector.

Pin	Type of Connection	Description	Comments
1 **		Protective Ground	A ground should be connected to all devices.
2 **	Terminal to Communication	Transmitted Data	Terminals and computers send on 2. Modems and communication gear receive on 2.
3 **	Communication to Terminal	Received Data	Terminals and computers receive on 3. Modems and communication gear send on 3. 3.
4 *	Terminal to Communication	Request to Send	Most terminal and computers keep this line positive. Some use positive only when they want to send.
5 *	Communication to Terminal	Clear to Send	Many terminals and computers watch this line and will not send unless it is set positive. If protocol is not used a connection to pin 4 allows the device to see its own request to send.
6 *	Communication to Terminal	Data Set Ready	Most modems keep this line set positive. Some terminals and computers will not send unless the pin is set. If protocol is disregarded then pins 4, 5, 6, 8, and 20 can be interconnected similar to pin 5.
7 **		Signal Ground	Should connect to all devices.
8 *	Communication to Terminal	Received Line Signal Detect	(Carrier Detect) Modem uses it to indicate receiving a signal signal (carrier) over the communication line. Some terminals and computers will not send unless it is positive. See pin 5 or 6 description to force signals.

RS-232 Pin Configuration

Pin	Type of Connection	Description	Comments
9		Reserved for testing	Permits terminals or computers to put communication gear (modem) into various test modes. It is not used in normal communication.
10		Reserved for testing	Same as 9 above.
11		Unassigned	No assigned use. Various manufacturers use it in specialized ways.
12	Communication to Terminal	Secondary #8	Used in some dual channel work but rarely used in simple interconnects.
13	Communication to Terminal	Secondary #5	Same as 12 above.
14	Terminal to Communication	Secondary #2	Same as 12 above.
15	Communication to Terminal	Transmit Clock	Used in some synchronous interconnections.
16	Communication to Terminal	Secondary #3	Same as 12 above.
17	Communication to Terminal	Receive Clock	Same as 15 above.
18		Unassigned	Same as 11 above.
19	Terminal to Communication	Secondary #4	Same as 12 above.
20 *	Terminal to Communication	Data Terminal Ready	Most terminals and computers keep this positive. Some modems will not work unless it is positive.
21	Communication to Terminal	Receiving Line Signal Quality	Communication gear uses it to indicate that the signal is being received is of high quality.

RS-232 Pin Configuration

Pin	Type of Connection	Description	Comments
22 *	Communication to Terminal	Ring Indicator	Modem uses it to indicate that the phone is ringing. The communication line wants to establish a connection.
23	Terminal to Communication	Clock rate source	Same as 15 above.
24	Terminal to Communication	Transmit Clock	Same as 15 above.
25		Unassigned	Same as 11 above.

** These pins should be used in all interconnections. Anyone that works with simple plugging and unplugging of communication lines must know the uses of these pins.

* These pins are frequently used in even simple interconnections. Computer technicians should know the uses of these pins.

General comments:

1. A positive voltage has a general tolerance defined between +3 and +25.
   A negative volt is between -3 and -25. Most signals are actually between 8 and 12 volts or -8 and -12 volts respectively.

2. In general a positive volt means the pin (or path) is considered "on" (or active, asserted, one, marked), while a negative voltage is "off" (or not active, unasserted, zero, space).

3. Pins 2, 3, 14 and 16 reverse the definitions. Voltage between +3 and +25 are considered "off" while negative voltage is "on."

Adapted from material provided by Ed McKay.

CST 2408: Data Communications and Networking

STUDENT'S GUIDE (LABORATORY)

Lab Assignment #3

Unit Title: Software Command Files

Assignment Associated With: Communications and Standards (Chapter 3)

Time Required: 2 hours

Objectives: Upon completion of this lab, the student will be able to:

1. Create the command files necessary for a network of two PCs.
2. Create an autoexec file to boot the necessary files without recreating them.
3. Describe the meaning of each specific command in the created files.

Materials Required:

Stand-alone PC lab
Cabling from Lab 2
EasyLAN Manual
Formatted blank disk (for each students)

Laboratory Handouts: EasyLAN configuration files (attached)

Learning Activities (assignments): Complete Lab 3

Steps:

1. Students will be in pairs with two PC per pair.
2. The students will set up the cabling for the network of two PCs.
3. Each pair will create the start up command file. It should include the following concepts:

   a. Time--the system time call
   b. Date--the system date call
   c. SRVDISP--the server dispatch
   d. SRVBPRT--the background pring job
   e. EZCHGC <the name of the /MG:C>--makes a change for the modem status to be checked
   f. CLS--clears the screen
4. Discuss each of the commands including the need for unique /MG:C> names.

EasyLAN Commands

The command structure of EasyLAN is similar to IBM's PC-DOS. EasyLAN commands may be issued from any computer connected to the EasyLAN network.

The computer issuing one of these EasyLAN commands is referred to as the LOCAL computer; other computers attached to the network which are the recipients of these commands are called REMOTE computers. Any computer can be considered local or remote, depending only on whether it issues commands or receives them. The exception to this difiniton is EZPRINT and the "EZ-change" commands, which operate only on the local computer. The following commands are supported:

1. EZDIR: Displays a list of all files contained in a Remote disk directory.
2. EZCOPY: Copies files to and from Remote PCs. Also available is EZCOPYB, a background command that in effect spools files between PCs.
3. EZREN: Changes the names files are stored on a Remote computer.
4. EZDEL (or EZERASE): Erases files on a Remote computer.
5. EZPRINT: Handles printing on PCs with printers attached.
6. EZCHGC: Allows the operator of a local computer to change parameters in the communications management module.
7. EZCHGBP: Allows the user to change the parameter in the background print module.
8. EZCHGP: Allows the operator of a Local computer to change the parameters of EasyLAN's virtual printer support.

All EasyLAN commands support the use of standard DOS filenames, extensions, subdirectory path and "wildcard" designators (* and ?).

EasyLAN Command Files

To interconnect two PCs, three EasyLAN comand files must be loaded from the EasyLAN diskette or the fixed disk when the system starts up:

1. **SRVDISP.COM** loads the EasyLAN background disk patcher.

2. **SRVBPRT.COM** reads a configuration file to determine what printers are attached to the PC. This command is required only on PC with network printers attached.

3. **SRVCOMM.COM** reads a configuration file to determine what Remote PCs attached to EasyLAN are supported. SRVCOMM.COM also provides the communications support and loads the background user and server applications.

In addition to these three command files, two configuration files must be loaded:

1. **SRVCOMM.CFG,** which defines the communication parameters used by the network, and

2. **SRVBPRT.CFG,** which defines the print parameters.

Information compiled from: EasyLAN Reference Manual, Version 1.0, 3rd Ed., Server Technology, Inc., 1985.

CST 2408: Data Communications and Networking

STUDENT'S GUIDE (LABORATORY)

Lab Assignment #4

Unit Title: External Facilities Tour

Assignment Is Associated With: LAN Hardware (Chapter 4)

Time Required: 2 hours

Objectives: Upon completion of this lab, the student will be able to:

1. List locations in the community that use networks.
2. Describe the types of networks used at three locations in the community.
3. Describe the advantages and disadvantages of three different network configurations.

Materials Required:

Bus/Vans for travel
Travel waivers (if necessary)
Notice to other classes students may miss due to the tour

Laboratory Handouts: None

Learning Activities (assignments):

1. Participate in the tour.

2. Turn in a paper describing at least two facilities in the community that use different network configurations. Discuss the equipment, software, workload and distribution in the system. Also describe the advantages and disadvantages involved in each system and the specific installations.

   The assignment must be at least two typed, double spaced pages of standard paper (8 1/2 by 11 inches). The paper must include at least two named references (article, title, publication, date, page and author cited). Short quotes from articles are accepted, but verbatum plagiarism will result in a grade of zero.

Steps:

1. Tour a facility (outside school) which has one or more of the following:

   Token-ring network.
   Token-bus network.
   Star network.

2. Write paper.

CST 2408: Data Communications and Networking

STUDENT'S GUIDE (LABORATORY)

Lab Assignment #5

Unit Title: Software command files for EasyLAN, 1 to many.

Assignment Associated With: Network Operating Systems (Chapter 5)

Time Required: 2 hours

Objectives: Upon completion of this lab, the student will be able to:

1. Create the command files necessary for a network of one server to many PCs.
2. Create an autoexec file to boot the necessary files without recreating them.
3. Describe the meaning of each specific command in the created files.

Equipment and Materials Required:

Stand-alone PC lab
Cabling necessary for 1 to many network
EasyLAN Manual
Formatted blank disk (for each student)

Laboratory Handouts: EasyLAN Commands (used in Lab 3)

Learning Activities (assignments): Complete lab 5

Steps:

1. Work individually at a PC workstation.
2. Set up the cabling for the network of PCs.
3. Have each pair of students create the start up command file. It should include the following concepts:

   a. Time--the system time call
   b. Date--the system date call
   c. SRVDISP--the server dispatch
   d. SRVBPRT--the background pring job
   e. EZCHGC <the name of the /MG:C>--makes a change in the modem status (be sure to include all other stations and peripherals).
   f. CLS--clears the screen

4. Participate in the discussion of commands. Differences in command files between Lab 3 and Lab 5 is an important aspect of the discussion.

CST 2408: Data Communications and Networking

STUDENT'S GUIDE (LABORATORY)

Lab Assignment #6

Unit Title: Evaluate Speed of Servers

Assignment Associated With: LAN Evaluation (Chapter 6)

Time Required: 4 hours

Objectives: Upon completion of this lab, the student will be able to:

1. Calculate the speed of file transfer for different servers.
2. Describe the security problems inherent in networks.
3. Execute 5 different intranetwork commands and time the speed on two different servers.

Equipment and Materials Required:

Networked PC lab (with EasyLAN)
Ability to use PC as server
Ability to use PC AT as server (or other higher power machine)
1 disk per student (with large, non-pre-extended files)
1 Stop watch per student (wrist watch with second hand is sufficient)
Students grouped in pairs

Laboratory Handouts: Log Sheet Command Execution Times (attached)

Learning Activities (assignments): Complete Lab 6

Steps:

1. Execute the steps in this lab with each of the different network configurations. If all the configurations are not available, modify for the numbers of concurrent commands on one machine (ie. expand on part a and b).

   a. star network with PC as server.
   b. star network with PC AT as server.
   c. two PC network with both machines PCs.
   d. two PC netword with PC AT as server.

2. As a class, download a large file from the server. It is vital that allstudents press the enter key simultaneously. As each machine completes the task, that group will record the time. Discuss the reasons and ramifications of the fastest and slowest times.

3. Check the time it takes to download entire systems.

   a. language compiler
   b. data base system disk
   c. word processor
   d. spreadsheet

4. Check the time it takes to execute software language commands that are stored on the server. Try 5 to 6 different commands. Make sure the commands are server related and not single machine commands. (DBase commands in the immediate mode work well.)

5. Check 15 more commands and record the times.

LOG SHEET
Command Execution Times

Name

COMMAND	TIME	CONFIGURATION	DESCRIPTION

CST 2408: Data Communications and Networking

STUDENT'S GUIDE (LABORATORY)

Lab Assignment #7

Unit Title: LAN Evaluations

Assignment Associated With: LAN Evaluation (Chapter 6)

Time Required: 2 hours

Objectives: Upon completion of this lab, the student will be able to do at least one of the following:

1. Evaluate 2 Network interface cards (NIC) for performance, capabilities and cost.
2. Evaluate 2 hardware configurations for performance, capabilities and cost.
3. Evaluate 2 network operating systems for performance, capabilities and cost.
4. Write a case study describing the best LAN a given situation.

Equipment and Materials Required:

Depends upon choices in the Steps below

Laboratory Handouts: None

Learning Activities (assignments): Complete Lab 7

Steps:

Depending upon the equipment available, do one or more of the following:

1. Evaluate for performance, capabilities and cost of two NIC's.

2. Evaluate for performance, capabilities and cost of two types of hardware configurations.

3. Evaluate for performance, capabilities and cost of two types of Network operating systems--repeat the steps in Lab 6 with a high quality network or mainframe system.

4. Using library references, write a two-to-three page paper on one of the following topics:

   a. File servers in the current market.
   b. LANs in the current market.
   c. LAN vs. File server capabilities.
   d. NICs in the current market.
   e. Case study describing the LAN to buy based on a specific need in the community.

CST 2408: Data Communications and Networking

STUDENT'S GUIDE (LABORATORY)

Lab Assignment #8

Unit Title: Data Integrity and File Organization

Assignment Associated With: LAN Management (Chapter 8)

Time Required: 2 hours

Objectives: Upon completion of this lab, the student will be able to:

1. describe the difference between pre-extended and fragmented files.
2. execute the commands needed to reorganize a disk in a pre-extended format.
3. list three levels that data integrity is secured when using LAN's.

Materials Required:

Networked PC lab
1 disk with pre-extended files
1 disk with fragmented files (use the disk from lab 6)
Displaywrite 4 system software (can substitute other software that demonstrates file reorganization)
1 disk with Displaywrite 4 files that are fragmented (can be the fragmented files disk above)
1 formatted blank disk (for file reorganization)
1 stop watch per group of students (or watch with second hand)

Laboratory Handouts: Log Sheet command Execution Times (used in Lab 6, may also need additional sheets)

Learning Activities (assignments): Complete Lab 8

Steps:

1. Security and Data Integrity (1 hour)
   a. Work in pairs. Have one student check out a file.
   b. Then have the partner try to check out the same file before the first student has checked it back in. (EasyLAN has file locking, others may allow for record locking.)
   c. Go through some commands that demonstrate data integrity.
   d. Go through commands that demonstrate record locking (if available).

2. File Organization (one-half hour)

   a. Check the time it takes to execute commands on both fragmented and pre-extended files. Compare the times to Lab 6.

      1. access an entire file
      2. access records withing a file
      3. change information in a file
      4. execute a simple program that access the files repeatedly

3. Creating a disk with pre-extended files (one-half hour)

   a. Boot up Displaywrite 4
   b. Execute the commands to reorganize the files on the disk.

CST 2408: Data Communications and Networking

STUDENT'S GUIDE (LABORATORY)

Lab Assignment #9

Unit Title: Security and Backups

Assignment Associated With: Security (Chapter 10)

Time Required: 4 hours

Objectives: Upon completion of this lab, the student will be able to:

1. Install a backup device.
2. Create directory paths.
3. Create subdirectories.
4. List three methods of securing data in a network.

Materials Required:

PC lab (networked 1 to 1, same as Lab 2)
2 disks per students (files on the disk will be reorganized into subdirectories).

Laboratory Handouts: None

Learning Activities (assignments): Complete Lab 9

Steps:

1. Security in Path Names.

   a. Work in pairs. (Groups may be larger if equipment dictates.)
   b. The PC's will be designated as Student 1-PC1 and Student 2-PC2 for clarification.
   c. Student 2 should make a backup disk of all files on PC2.
   d. Student 1 should log on to PC1 then copy all the files on PC2.
   e. Student 1 will then delete the files on PC2.
   f. Have Student 1 change the path name.
   g. Have Student 2 try to find files on PC2.
   h. Have Student 2 try to get files back from PC1. (Impossible without path name).
   i. Have Student 1 put the information back on Student 2's disk.
   j. Student 2 should then put another disk in PC2 and have Student 1 access it. (Student 1 should have no problems because PC2's path name has not changed).
   k. Continue with additional path manipulation.

2. Security with directory names and trees.

   a. Working individually, reorganize a disk using directory trees.
   b. After the files are reorganized regroup in original pairs. Have student 1 try to access files in PC2's subdirectories and vice-a-versa?

      1. First try without knowing subdirectory names.
      2. Then try with knowledge of the names.

   c. Change partners and repeat procedure.

3. As a class, discuss the different:

   a. Naming techniques from person to person.
   b. Naming standards within a network.
   c. Security problems in path, directory and file names.

CST 2408: Data Communications and Networking

STUDENT'S GUIDE (LABORATORY)

Lab Assignment #10

Unit Title: Backup Systems

Assignment Associated With: Installation (Chapter 11)

Time Required: 2 hours

Objectives: Upon completion of this lab, the student will be able to:

1. Write the command files for a tape backup system
2. Connect a backup tape system to networked PCs

Materials Required:

Networked PC lab
1 tape drive system per group (4 students)
1 manual on tape drive per group

Laboratory Handouts: Command File Changes (Individual institutions need to develop the handout based upon available equipment.)

Learning Activities (assignments): Complete Lab 10

Steps:

1. Install a backup tape drive system including:

   a. hardware changes
   b. software changes

2. Write the command files for a tape backup system.
3. Connect a backup tape system to networked PCs.

CST 2408: Data Communications and Networking

STUDENT'S GUIDE (LABORATORY)

Lab Assignment #11

Unit Title: A Touch of Reality

Assignment Associated With: Maintenance and Diagnostics (Chapter 13)

Time Required: 4 hours

Objectives: Upon completion of this lab, the student will be able to:

1. Clean disk drives
2. Clean floppy disks
3. Clean computers
4. Recover data from a bad disk
5. Maintain and organize files on a disk

Materials Required:

Networked PC lab
Maintenance programs
Disk Mechanic program
RAM Test program
File Clerk program
Cleaning programs and material
Disk cleaning system
Rubbing alchohol
1 soft paint brush or toothbrush for 3 students
Small tool kit (for tightening, etc.)

Laboratory Handouts: Cleaning Computer Equipment (attached)

Learning Activities (assignments): Complete Lab 11

Steps:

1. Run diagnostics program and test for

   a. Hardware
   b. Peripherals
   c. Path congestion

2. Clean equipment

   a. Toothbrush keyboards etc.
   b. Run the disk drive cleaning program
   c. Clean the disks
   d. Clean the screens
   e. Clean any peripheral equipment

3. File maintenance and recovery

   a. take a disk with no errors
   b. make a backup copy of the disk
   c. place a magnet on the disk
   d. try to use the disk
   e. run the file recovery program

4. Take a one-half hour tour of the mainframe computer facility and have the computer staff describe mainframe maintenance and diagnostic procedures.

5. Divide the class into three groups. Each group will make a presentation on one of topics below. The group presentation will be allotted 20 minutes. The presentations will occur during the lecture sessions on the 15th week of class.

   a. Software vendors on these and other topics.

      1. licensing laws
      2. user limitations
      3. network capabilities with the software

   b. Careers in the networked environment.
   c. Hardware vendors on these and other topics.

      1. NICs
      2. Drives
      3. Secondary storage
      4. Chips

Cleaning Computer Equipment

All equipment needs some type of cleaning and routine maintenance. The schedules for maintenance can be found in the owners manuals. The most efficient method to ensure proper care is to create a master calender for cleaning and maintenance of all equipment based upon the recommendations in the owners manuals. In addition to the owners manuals, a few quick tips may be helpful.

Computer Room(s)

1. Keep the room reasonably free from dust and static.
2. A safe temperature is between 41 and 95 degrees F.
3. Make sure there is a master surge protector for the room.
4. Keep paper clips, matches, and liquid away from all equipment.
5. Make sure all power sources are disconnected before cleaning.

Terminal/Computer(s)

1. Wipe with a slightly damp cloth to remove dirt and dust.
2. Rubbing Alcohol may be needed to remove old tags or stickers.
3. Use only a slightly damp cloth or the recommended cleaner on the screens. Screen are made from diverse material; therefore, one cleaner will work for all.

Keyboard(s)

1. Vacuum using a small vacuum cleaner with a soft attachment.
2. Rubbing alcohol may be needed to remove old tags or stickers.
3. A slightly damp cloth and soft paint brush may be used to clean between the keys.

Printer(s)

1. Clean the printer case with a slightly damp cloth.
2. Remove the dust cover and vacuum the inside using a small vacuum cleaner with a soft attachment.
3. Remove the paper and vacuum around the cylinder using a small vacuum cleaner with a soft attachment.
4. Be careful not to bend or damage the parts and alignment.

Cleaning Computer Equipment

Disk/Tape Drive(s)

1. Vacuum the cover using a small vacuum cleaner with a soft attachment.
2. Gently wipe the columns and heads. (Do NOT manually clean the disk drives. Use a disk drive cleaning package).
3. Be careful not to bend or damage the parts and alignment.

CST 2408: Data Communications and Networking

STUDENT'S GUIDE (LABORATORY)

Lab Assignment #12

Unit Title: Electronic Mail

Assignment Associated With: Electronic Mail (Chapter 16)

Time Required: 4 hours

Objectives: Upon completion of this lab, the student will be able to:

1. Use an electronic mail package.
2. Write a program to simulate a simple electronic mail package.
3. Create the commands to "dial up" a Wide Area Network (WAN).
4. Download information from a WAN.

Materials Required:

Networked PC lab
WAN communication license
Modems for communication

Laboratory Handouts: WAN Configuration File (individual institutions need to develop the handout based upon available WAN access.)

Learning Activities (assignments): Complete Lab 12

Steps:

1. Electronic Mail package (one-half hour)
   a. Discuss the capabilities of a particular package
   b. Use the package to communicate with each other

2. WAN communication (one hour)

   a. Discuss available WANs
   b. Setup the particular WAN configuration files
   c. Download information from the WAN

3. Write a simple electronic mail program (1 1/2 hours)

INSTRUCTOR'S COURSE SYLLABUS

CST 2408: Data Communications and Networking

INSTRUCTOR'S COURSE SYLLABUS

Course Title: Data Communications and Networking

Course Number:

CST	2408	3	2	4
Prefix	No.	Lecture Hrs.	Lab Hrs.	Credit Hrs.

Catalog Description:

An introduction to networking techniques, systems, and problems. Topics include interfacing techniques, common peripherals, compatibility, and network design and modeling.

Prerequisites:

CSC 1301--Introductory Computing: Basic principles of computing. Input/output media. Computer software, number system, flow charting and programming. Applications of computers in business and industry.

CSC 1305--Logic and Theory: This course covers the classic, symbolic and mathematical elements of logic and their relation to computers and data processing logic and theory. Emphasis is placed on logic development through program flowcharts and structure charts.

CST 2403--Fundamentals of Hardware: An introduction to hardware fundamentals. Topic include constructing sample digital circuits, circuit design fundamentals, peripheral linkage design and interfaces. Operational characteristics of and implementation factors involving different computers and peripherals (graphic adapters, multifunction cards, auxiliary storage devices and alternative I/O devices). Optimal combinations of hardware and applications software in problem solving.

Co-Requisite:

CST 2401--Operating Systems: An introduction to functional components of a computerized operating system. Topics include system structure hardware usage, processing levels, resource utilization, scheduling discussions, dispatching, multitasking, and file management.

Text:

Networking IBM PC's, 2nd edition, by Michael Durr, QueCorp., 1987.

Alternate Texts:

Communication and Networking for IBM PC, by Larry E. Jordan & Bruce Churchill, Simon and Schuster Pub. Co., 1986.

The Practical Guide To Local Area Networks, by Roland Archer, Osborne Mc-Graw-Hill, 1986.

References:

The Practical Guide To Local Area Networks, by Roland Archer, Osborne Mc-Graw-Hill, 1986.

What Every Engineer Should Know About Data Communications, by Carl Stephen Clifton, Marcel Dekker,INC., New York and Basel, 1987.

Data Communications and Distributed Networks, by Uyless D. Black, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1987.

Micro to Mainframe Links, by Ronald F. Kopeck, Osborne McGraw-Hill, Berkeley, California, 1986.

Guide to IBM PC Communications, David Kruglinski, Osborne McGraw-Hill, Berkeley, California, 1984.

Handbook of Software & Hardware Interfacing for IBM PCs, by Jeffrey P. Royer, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1987.

EasyLAN Reference Manual, Version 1.0, 3rd Ed., Server Technology, Inc., 1985.

Tools and Their Uses, by U.S. Navy Bureau of Naval Personnel, Dover Pub. Co., 1973.

EPSON User's Manual, FX-85/185 Printers, Epson Corporation, Nagana, Japan, 1985.

Installing and Using the LA75 Companion Printer, by Education Services of Digital Equipment Corporation, 1986.

Equipment and Materials Required:

Minimum:

IBM PC (or compatible) with 2 disk drives per student.
15 Feet of cabling with 2 connectors per student.
EasyLAN software and manual per student.

Recommended:

High quality full network including hardware and software (to demonstrate the high end of the scale.)
IBM PC-AT Server with a minimum of 20 MG Hard disk.
IBM PC with 2 disk drives (networked) per student.
COM ports for each PC per student.
Soldering iron and solder for every 2 students.
EasyLAN software and manual per student plus one for the file server.
Modems for WAN communications including license.
2 types of Network Interface cards for every 2 students.
2 formatted blank disk for every student.
Disk with pre-extended files for every student.
Disk with fragmented files for every student.
Tape drive and manual for every 4 students.
Disk drive cleaning program.
"RAM test" program.
"File Clerk" program.
Volt meter.
15 Feet of cabling with 2 connectors per student.
Small tool kit for every 4 students.
Wire strippers for every 2 students.
Pliers for every 2 students.
Rubbing alcohol.
2 small vacuum cleaners with dust brushes.
Soft paint brush or toothbrush for every 3 students.
Stop watch or wrist watch with second hand for every student.

Instructional Process:

1. Lecture, discussion, and demonstration will be based upon the text and Instructor's Guide for each unit. Student's Lecture Guides provide outlines of lecture content, objectives, and requirements for each unit. Students should be encouraged to write definitions for vocabulary words provided in Student's Lecture Guides.

2. Student's Laboratory Guides provide outlines of laboratory assignments, equipment and materials required, and steps to follow to complete each lab assignment. Equipment lists and additional information to complete lab assignments are also included in the Instructor's Guides for each unit.

3. Tests and quizzes will be given periodically. Sample questions are attached to this syllabus.

4. Homework will be assigned as necessary.

Evaluation of Students:

Examinations: Three unit exams and a final exam will be given during the semester. NO MAKE-UP EXAMS WILL BE GIVEN WITHOUT PRIOR APPROVAL.

Quizzes: Quizzes will be administered periodically throughout the semester. The quiz will be similar to exam questions. NO MAKE-UP QUIZZES WILL BE GIVEN REGARDLESS OF REASON FOR ABSENCE.

Laboratory/Homework: Assignments generally will be due at the end of the week. Late assignments will be accepted for one week after the due date with a 20% reduction in grade. After one week, assignments will not be accepted.

Final Grade Determination:

Grades for the semester will be determined based on the accumulated points earned. To determine a tentative grade, divide the total points earned by the total possible points. The grading scale will be strictly: 90, 80, 70, 60 percent of the possible points.

Approximately 40% of the total points will be from lab assignments and homework, 40% from tests and quizzes, and 20% from the final exam.

Competency Statements:

Microcomputer Applications Program exit competencies upon which course is based.

Section I: Job Processing

A. Introduction/overview

1. Demonstrate a general knowledge of computer system analysis and design.
2. Demonstrate a general knolwedge of commercial application packages.
3. Demonstrate a general knowledge of the need and development of local area networks.

B. Data Communications

1. Describe PROTOCOL and how it is used.
2. Demonstrate the ablility to link microcomputers together.
3. Demonstrate ability to link the microcomputer to the mainframe.
4. Demonstrate knowledge of local area networks (LAN).
5. Demonstrate ability to link microcomputer to databases such as CompuServe, the Source, and Dialog.

Section II: Hardware Operations

A. Data Processing Equipment

1. Oversee networking of terminals.
2. Load, start, and unload disk drives.
3. Interpret and apply instructions from written procedures.
4. Keep logs of runs and job status.
5. Keep logs of equipment problems.
6. Follow proper security, emergency, and backup procedures.
7. Recover data after power failure.
8. Notify supervisors or management of machine failure, or processing problems.
9. Perform minor maintenance on microcomputer.
10. Verify quality of microcomputer output.

B. Peripheral Equipment

1. Perform power-up-down procedures for peripheral equipment.
2. Perform routine maintenance on peripheral devices.
3. Operate printer.
4. Set up printer with continous forms, single pages, etc.
5. Remove printed data output.
6. Operate external random disk (hard disk, video disk, etc.).
7. Operate modem.

C. Emergency Procedures

1. Perform hardware recovery operations.
2. Perform emergency backups and power downs.

Section III: Supervisory Functions

A. Product Control

1. Enforce microcomputer security program (control of data.)
2. Create command files to control data security.
3. Demonstrate a general knowledge of LAN standards.

B. Equipment Operations

1. Assist with selection and purchasing of data processing equipment.
2. Consult with systems designers on programming requirements of new systems (software and hardware).
3. Define systems interface or integration requirements.
4. Recommend modification of systems to management and/or users.
5. Estimate systems requirements and capabilities.
6. Determine system scheduling and job priorities.
7. Demonstrate a general knowledge of evaluating LAN's.
8. Demonstrate a general knowledge of LAN inter-connectivity.

Section IV: Housekeeping Functions, Routine

A. Routine Maintenance of Equipment

1. Inspects diskettes and harddisk for damage.
2. Loads paper in printer.
3. Verifies diagnostic tests.
4. Demonstrate a general knowledge of LAN diagnostics.

B. Records Maintenance

1. Maintains integrity and confidentiality of data.
2. Maintains an operation log of microcomputer operation.
3. Maintains files or reports, regulations or directive pertaining to data.
4. Maintains backup procedure reports and records.
5. Reviews and evaluates output and reports for accuracy.
6. Recognizes errors in other than keyed data.
7. Initiates corrections of discovered errors.
8. Organizes files of job instructions.
9. Requisitions and maintains inventory of data processing supplies.

Course Outline:

Contents of Unit 1: The Development of LANs

1. The Growth of Office Automation
2. The Local Area Network Defined

a. Components of the Network
   1. Cable
   2. Network Interface Card
   3. Network Servers
   4. Central Mass Storage
   5. Workstations

b. The Development of Network Applications

c. The Network as a Communications System

3. LANs in Action

Contents of Unit 2: Examining the Alternatives

1. Why Connect to a Network?

    a. Resource Management
    b. PCs in a Host System
    c. Networking Alternatives

2. How Is a LAN Structured?

Contents of Unit 3: Communications and Standards

1. The OSI Model

    a. Layer 1: Physical
    b. Layer 2: Data-Link
    c. Layer 3: Network
    d. Layer 4: Transport
    e. Layer 5: Session
    f. Layer 6: Presentation
    g. Layer 7: Application

2. Software Standards - the Subnet
3. The LAN File Server Standard
4. Software Standards - the Presentation Layer
5. DOS Multiuser Support

Contents of Unit 4: LAN Hardware

1. Cable Alternatives
2. LAN Topologies
3. Cable Access Schemes
4. Network Interface Cards

    a. Ethernet
    b. AT&T Starlan
    c. Corvus Omninet
    d. Gateway Communications' G-Net
    e. IBM PC Cluster
    f. IBM PC Network
    g. Orchid PC Net
    h. 3COM EtherLink
    i. Ungermann-Bass Net/One Personal Connection

5. Token Bus Networks

    a. Allen-Bradley VistaLAN/PC
    b. Nestar Plan Series

6. Token-Ring Networks

    a. IBM Token-Ring
    b. Proteon ProNET

7. Star Networks

    a. Novell S-Net

8. Network Servers

9. Servers Alternatives

    a. IBM PC XT
    b. IBM PC AT
    c. Nestar Plan 5000
    d. Novell S-Net Server
    e. Novell 286A/B
    f. 3Com 3Server

Contents of Unit 5: Network Operating Systems

1. Network Utilities
2. The File Server
3. IBM PC Local Area Network Program

    a. Installing PCLANP
    b. PCLANP Commands
    c. Using PCLANP

4. 3Com 3+

    a. Installing 3+
    b. 3+ Commands
    c. Using the 3+ Network

5. Novell Advanced NetWare

    a. Installing NetWare
    b. NetWare Commands
    c. Using the NetWare Network

Contents of Unit 6: LAN Evaluation

1. The Physical Site
2. Network Functions
3. Evaluating NICs
4. Evaluating Servers
5. Evaluting Operating Systems
6. Estimating Hardware Performance
7. The Performance Formula
8. New Products

Contents of Unit 7: Applications Software

1. Hard Disk Compatibility
2. Site Licensing
3. Single-User Applications
4. A Multiuser Approach
5. Smart Single-User Software
6. Programming on the Net

Contents of Unit 8: LAN Management

1. Choosing the Network Supervisor
2. Mapping Out the Network: The Initial Planning
3. Organizing Files
4. Assigning Users
5. Setting Up Directories
6. Determining What Files Go on the Network
7. Using Decriptive Names To Identify Files
8. Using the Front-End Approach.

Contents of Unit 9: Data Protection

1. Using Backup Devices
2. Selecting a Tape System
3. Correcting Errors
4. Software Considerations
5. Two Tape BackupSystems: Steaming and File-by-File
6. Performing the Backup Operation
7. Making Your System Fault Tolerant
8. Saving Hard Disk Space by Archiving Files

Contents of Unit 10: Security

1. Networks and Security
2. Risk Analysis
3. Levels of Security
    a. Physical Security
    b. Personal Identification
    c. Passwords
    d. Security in Login
    e. Encryption
        1. Encryption Keys
        2. On-Line Coders
    f. The Diskless PC
    g. Protection against Cable Radiation
    h. Call-Back Security

Contents of Unit 11: Installation

1. The Installation Log
2. Cable Distribution
3. Planning Ahead
4. Cable Handling
5. Cable Connectors
6. Fire-Retardant Cable
7. Cable Testing
8. Fault Tolerance
9. Interference
10. Grounding

Contents of Unit 12: Performance

1. The Data Path
    a. Using Disk Caching To Speed Up Network Operation
    b. Improving Access Time by Organizing Files
2. Network Servers: How Many To Use?
    a. Solving Disk Channel Problems
    b. Avoiding Cable Bottlenecks

Contents of Unit 13: Maintenance and Diagnostics

1. Network Control Center
2. Local Area Network Diagnostics
3. NetWare Diagnostics
4. Diagnostics in Hardware
5. The Role of the Network Manager
6. Network Monitoring
7. Looking Ahead

Contents of Unit 14: Internetting

1. Internet Hardware
2. Remote Interconnection
3. Asynchronous Gateways and Modem Pools
4. X.25 for Wide Areas
5. X.25 Options
6. Conclusion

Contents of Unit 15: The Mainframe Connection

1. Terminal Evaluation
2. How To Evaluate an Emulator
3. The Emulator on the Network
4. Mainframe Gateways: Alternatives to Terminal Emulation
5. PCs as Mainframe Workstations
6. Backup on the PC
7. Downtime Equals Loss

Contents of Unit 16: Electronic Mail

1. Defining Electronic Mail
2. Using Electronic Mail
3. Evaluating Electronic Mail
4. An Intraoffice Study
5. Interoffice Mail

CST 2408: Data Communications and Networking
Chapters 1-4
Test # 1

Name

Point Value: 100

Essay Questions

Choose 4 of the 5 topics for 25 points each.

1. Describe the development of a network. Define the difference between a networked system and a mainframe system. List and describe the components of a network along with the reasons networked microcomputers seem to be a major component in the future of computer technology.

2. Describe two alternatives to a network. Include in the description the advantages and disadvantages to the alternatives as compared to a networked system.

3. List and describe the seven layers of the OSI model. Include in the discussion, the interrelatedness of each layer.

4. Describe two types of networks. Include in the discussion the advantages and disadvantages of each.

5. Describe three types of network servers. Include in the discussion the advantages and disadvantages of each.

CST 2408: Data Communications and Networking
Chapters 5-8
Test # 2

Name

Point Value: 100

Essay Questions

Choose 4 of the 5 topics for 25 points each.

1. Describe a network operating system. Include in the description the installation procedure and advantages of the operating system.

2. Describe a network environment. Include in the description the physical site, hardware (with NIC and server), operating system, and network function.

3. Describe the performance formula used to analyze throughput. Describe the number and type of users along with the meaning of the throughput formula.

4. Describe the process involved in purchasing network system software. Include a specific example of software, site licensing, and installation procedures.

5. Describe a case study of network supervision. Include in the discussion the file organization, user assignments, and directories available to specific users (with examples of file names).

CST 2408: Data Communications and Networking
Chapters 9-12
Test # 3

Name

Point Value: 100

Essay Questions

Choose 4 of the 5 topics for 25 points each.

1. Describe the need for data protection. Within the discussion describe at least three levels at which data can be protected. Give examples where each type of protection would be used.

2. Describe three methods of insuring system integrity. Include a detailed analysis of one of the methods.

3. List four sources of interference in communication and include methods to overcome the problems that may occur.

4. List two methods used to evaluate performance of a networked system. Give examples of how each method can be used to increase productivity.

5. Describe a case study involving a company installing a network. Include a description of the physical facilities and the steps followed from inception to implementation.

CST 2408: Data Communications and Networking
Chapters 1-16
Final Examination

Name

Point Value: 200

Essay Questions

Choose 8 of the 10 topics for 25 points each.

1. Describe the development of a network. Define the difference between a networked system and a mainframe system. List and describe the components of a network along with the reasons networked microcomputers seem to be a major component in the future of computer technology.

2. List and describe the seven layers of the OSI model. Include in the discussion, the interrelatedness of each layer.

3. Describe the need for data protection. Within the discussion describe at least three levels at which data can be protected. Give examples where each type of protection would be used.

4. Describe a case study of network supervision. Include in the discussion the file organization, user assignments, and directories available to specific users (with examples of file names).

5. Describe a case study involving a company installing a network. Include a description of the physical facilities and the steps followed from inception to implementation.

6. Describe three network diagnostic tools. Include the type, use and need for the diagnostic tool in the description.

7. List and describe the levels at which internetting can occur. For two of the levels also include a description of a common protocol used.

8. Describe three major problems that can arise when networking microcomputer to mainframes. Include in the discussion methods used to correct the problems.

9. Discuss the advantages and disadvantages of using a PC for backup procedures. Describe two different types of PCs in the discussion.

10. Define electronic mail and describe the components in electronic mail packages. Also include the advantages and disadvantages of using electronic mail.

INSTRUCTOR'S GUIDE

CST 2408: Data Communications and Networking

INSTRUCTOR'S GUIDE

Unit 1

Unit Title: The Development of LANs

Contents of Unit:

1. The Growth of Office Automation
2. The Local Area Network Defined
   a. Components of the Network
      1. Cable
      2. Network Interface Card
      3. Network Servers
      4. Central Mass Storage
      5. Workstations
   b. The Development of Network Applications
   c. The Network as a Communications System
3. LANs in Action

Unit Objectives: Upon completion of this unit, the student will be able to:

1. Describe the growth of office automation.
2. Define what constitutes a local area network.
3. Describe the parts of LAN.

Equipment and Materials Required:

Lecture:

Text
Student's Lecture Guide (Unit 1)
Hardware:
Cable
Male and Female connectors
Interface card
Hard Disk or Tape (to show mass storage device)

Laboratory:

Student's Laboratory Guide (Lab 1)
Networked PC lab
Access to all computer areas for a tour

Procedures:

Lecture:

Lecture
Demonstration

Laboratory:

Tour
Demonstration
Discussion

Learning Activities:

Lecture: Read Chapter 1

Laboratory: Complete Lab 1

Evaluation:

Lecture: Quiz #1 (Chapter 1) (objective)

CST 2408: Data Communications and Networking

INSTRUCTOR'S GUIDE

Unit 2

Unit Title: Examining the Alternatives

Contents of Unit:

1. Why Connect to a Network?
   a. Resource Management
   b. PC's in a Host System
   c. Networking Alternatives
2. How Is a LAN Structured?

Unit Objectives: Upon completion of this unit, the student will be able to:

1. Define and describe a resource management situation.
2. Describe networking alternatives.
3. Describe the difference between a LAN and PBX or shared-processor system.
4. Describe the conditions needed for LAN to be the best solution.

Equipment and Materials Required:

Lecture:

Text
Student's Lecture Guide (Unit 2)

Laboratory:
Student's Laboratory Guide (Lab 2)
stand-alone PC (one per student)
15 feet of cable per 2 students
2 RS232 connectors per 2 students
Solder (one roll)
Soldering iron (1 for every 2 to 4 students)
Wire strippers (1 for every 2 to 4 students)
Pliers (1 for every 2 to 4 students)
Volt meter

Procedures:

Lecture:

Lecture
Demonstration

Laboratory:

Demonstration
Group work
Discussion

Learning Activities:

Lecture: Read Chapter 2

Laboratory: Complete Lab 2

Evaluation:

Lecture: None

CST 2408: Data Communications and Networking

INSTRUCTOR'S GUIDE

Unit 3

Unit Title: Communications and Standards

Contents of Unit:

1. The OSI Model
   a. Layer 1: Physical
   b. Layer 2: Data-Link
   c. Layer 3: Network
   d. Layer 4: Transport
   e. Layer 5: Session
   f. Layer 6: Presentation
   g. Layer 7: Application
2. Software Standards-the Subnet
3. The LAN File Server Standard
4. Software Standards-the Presentation Layer
5. DOS Multiuser Support

Unit Objectives: Upon completion of this unit, the student will be able to:

1. List in order the seven layers of the International Organization Standard's Open System Interconnection (OSI) model.
2. Describe each of the seven layers of OSI including interconnectivity between levels.
3. Describe the software standards for:
   a. The subnet
   b. Presentation layers
   c. File servers
4. Define DOS Multiuser support.

Materials Required:

Lecture:

Text
Student's Lecture Guide (Unit 3)

Laboratory:

Student's Laboratory Guide (Lab 3)
Stand-alone PC lab
Cabling created in from lab 2
EasyLAN Manual
Formatted blank disk (for each student)

Procedures:

Lecture:

Lecture
Demonstration

Laboratory:

Demonstration
Group work
Discussion

Learning Activities:

Lecture: Read Chapter 3

Laboratory: Complete Lab 3

Evaluation:

Lecture: Quiz #2 (Chapters 2-3) (objective)

CST 2408: Data Communications and Networking

INSTRUCTOR'S GUIDE

Unit 4

Unit Title: LAN Hardware

Contents of Unit:

1. Cable Alternatives
2. LAN Topologies
3. Cable Access Schemes
4. Network Interface Cards
   a. Ethernet
   b. AT&T Starlan
   c. Corvus Omninet
   d. Gateway Communications' G-Net
   e. IBM PC Cluster
   f. IBM PC Network
   g. Orchid PC Net
   h. 3COM EtherLink
   i. Ungermann-Bass Net/One Personal Connection
5. Token Bus Networks
   a. Allen-Bradley VistaLAN/PC
   b. Nestar Plan Series
6. Token-Ring Networks
   a. IBM Token-Ring
   b. Proteon ProNET
7. Star Networks
   a. Novell S-Net
8. Network Servers
9. Servers Alternatives
   a. IBM PC XT
   b. IBM PC AT
   c. Nestar Plan 5000
   d. Novell S-Net Server
   e. Novell 286A/B
   f. 3Com 3Server

Unit Objectives: Upon completion of this unit, the student will be able to:

1. Describe cabling schemes and alternatives.
2. Describe at least 3 LAN topologies including specific product examples.
3. List the pros and cons of at least 3 network interface cards.
4. List the pros and cons of at least 3 network servers.
5. Choose the appropriate hardware and topology for any specific case study.

Equipment and Materials Required:

Lecture:

Text
Student Lecture Guide (Unit 4)

Laboratory:

Get permission from businesses wtih network for tour.
Student Laboratory Guide (Lab 4)
Bus/Vans for travel
Travel waivers (if necessary)
Notice to classes if students must miss

Procedures:

Lecture:

Lecture

Laboratory:

Tour
Discussion

Learning Activities:

Lecture: Read Chapter 4

Laboratory: Complete Lab 4

Evaluation:

Lecture: Test #1 (Chapters 1-4) (objective)

CST 2408: Data Communications and Networking

INSTRUCTOR'S GUIDE

Unit 5

Unit Title: Network Operating Systems

Contents of Unit:

1. Network Utilities
2. The File Server
3. IBM PC Local Area Network Program
   a. Installing PCLANP
   b. PCLANP Commands
   c. Using PCLANP
4. 3Com 3+
   a. Installing 3+
   b. 3+ Commands
   c. Using the 3+ Network
5. Novell Advanced NetWare
   a. Installing NetWare
   b. NetWare Commands
   c. Using the NetWare Network

Unit Objectives: Upon completion of this unit, the student will be able to:

1. Define the responsibilities of a network operating system.
2. Describe the installation procedure for at least 3 network operating systems.
3. Describe the commands needed to use at least 3 network operating systems.

Equipment and Materials Required:

Lecture:

Text
Student Lecture Guide (Unit 5)

Laboratory:

Student's Laboratory Guide (Lab 5)
Stand-alone PC lab
Cabling necessary for 1 to many star network
EasyLAN Manual
Formatted blank disk (for each student)

Procedures:

Lecture:

Lecture

Laboratory:

Demonstration
Individual work
Discussion

Learning Activities:

Lecture: Read Chapter 5

Laboratory: Complete Lab 5

Evaluation:

Lecture: None

CST 2408: Data Communications and Networking

INSTRUCTOR'S GUIDE

Unit 6

Unit Title: LAN Evaluation

Contents of Unit:

1. The Physical Site
2. Network Functions
3. Evaluating NICs
4. Evaluating Servers
5. Evaluating Operating Systems
6. Estimating Hardware Performance
7. The Performance Formula
8. New Products

Unit Objectives: Upon completion of this unit, the student will be able to:

1. List at least 3 reasons the physical site must be described in detail before selecting networking equipment.
2. Define the functions of a local area network.
3. List the four characteristics of a network interface card (NIC).
4. Define the criteria used to describe network servers.
5. Define the criteria used to evaluate network operating systems.
6. Estimate hardware throughput performance.
7. Estimate system throughput performance.

Equipment and Materials Required:

Lecture:

Text
Student Lecture Guide (Unit 6)

Laboratory:

Student Laboratory Guide (Lab 6)
Networked PC lab (with EasyLAN)
Ability to use PC as server
Ability to use PC AT as server
1 disk per student (with large non-pre-extended files)
1 stop watch per student (wrist watch with secondhand is sufficient)

Procedures:

Lecture:

Lecture
Demonstration

Laboratory:

Group work
Demonstration
Discussion

Learning Activities:

Lecture: Read Chapter 6

Laboratory: Start Lab 6

Evaluation:

Lecture: Quiz #3 (Chapters 5-6) (objective)

CST 2408: Data Communications and Networking

INSTRUCTOR'S GUIDE

Unit 7

Unit Title: Applications Software

Contents of Unit:

1. Hard Disk Compatibility
2. Site Licensing
3. Single-User Applications
4. A Multiuser Approach
5. Smart Single-User Software
6. Programming on the Net

Unit Objectives: Upon completion of this unit, the student will be able to:

1. Describe hard disk compatibility problems.
2. Define the difference between site and single user licenses.
3. Describe the precautions that must be included in programs that are used in a networking environment.

Equipment and Materials Required:

Lecture:

Text
Student Lecture Guide (Unit 7)
Software Packages

Laboratory:

Student Laboratory Guide (Lab 6 continued)
See materials listed in Instuctor's Guide--Unit 6

Procedures:

Lecture:

Lecture
Demonstration

Laboratory: None

Learning Activities:

Lecture: Read Chapter 7

Laboratory: Complete Lab 6

Evaluation:

Lecture: None

CST 2408: Data Communications and Networking

INSTRUCTOR'S GUIDE

Unit 8

Unit Title: LAN Management

Contents of Unit:

1. Choosing the Network Supervisor
2. Mapping Out the Network: The Initial Planning
3. Organizing Files
4. Assigning Users
5. Setting Up Directories
6. Determining What Files Go on the Network
7. Using Descriptive Names To Identify Files
8. Using the Front-End Approach.

Unit Objectives: Upon completion of this unit, the student will be able to:

1. Know the steps in mapping out a network.
2. Describe the reasons files must be organized according to owners, users, and privileges.
3. Describe common standards for setting up and naming files.
4. List criteria used to determine if a file should be network accessible.

Equipment and Materials Required:

Lecture:

Text
Student's Lecture Guide (Unit 8)

Laboratory:

Student's Laboratory Guide (Lab 7)
Depends upon hardware available

Procedures:

Lecture:

Lecture
Demonstration

Laboratory:

Tour
Demonstration
Discussion

Learning Activities:

Lecture: Read Chapter 8

Laboratory: Complete Lab 7

Evaluation:

Lecture: Test #2 (Chapters 5-8) (objective)

CST 2408: Data Communications and Networking

INSTRUCTOR'S GUIDE

Unit 9

Unit Title: Data Protection

Contents of Unit:

1. Using Backup Devices
2. Selecting a Tape System
3. Correcting Errors
4. Software Considerations
5. Two Tape Backup Systems: Streaming and File-by-File
6. Performing the Backup Operation
7. Making Your System Fault Tolerant
8. Saving Hard Disk Space by Archiving Files

Unit Objectives: Upon completion of this unit, the student will be able to:

1. Describe the need for data protection.
2. List at least 3 common backup devices.
3. Describe the criteria for selecting a specific tape system.
4. Define both a hard and soft error.
5. Describe the advantages and disadvantages of streaming and file-by-file backup systems.
6. Describe the process and reasons for archiving files.

Equipment and Materials Required:

Lecture:

Text
Student's Lecture Guide (Unit 9)

Laboratory:

Student's Laboratory Guide (Lab 8)
Networked PC lab
1 disk with pre-extended files
1 disk with fragmented files (use disk from Lab 6)
Displaywrite 4 system software (can substitute other software that demonstrates file reorganization)
1 disk with Displaywrite 4 files that are fragmented (can be the fragmented files disk above)
1 formatted blank disk (for file reorganization)
1 stop watch per group of students (or watch with second hand)

Procedures:

Lecture:

Lecture
Demonstration

Laboratory:

Group work
Demonstration
Discussion

Learning Activities:

Lecture: Read Chapter 9

Evaluation:

Lecture: None

Laboratory: None

CST 2408: Data Communications and Networking

INSTRUCTOR'S GUIDE

Unit 10

Unit Title: Security

Contents of Unit:

1. Networks and Security
2. Risk Analysis
3. Levels of Security

    a. Physical Security
    b. Personal Identification
    c. Passwords
    d. Security in Login
    e. Encryption

        1. Encryption Keys
        2. On-Line Coders

    f. The Diskless PC
    g. Protection against Cable Radiation
    h. Call-Back Security

Unit Objectives: Upon completion of this unit, the student will be able to:

1. Describe the necessity for network security.
2. List the levels of network security.
3. Describe three short case studies that demonstrate the need for at least 3 of the network security levels.

Equipment and Materials Required:

Lecture:

Text
Student's Lecture Guide (Unit 10)

Laboratory:

Student's Laboratory Guide (Lab 9)
PC lab (Networked 1 to 1)
2 disks per student (for subdirectory procedures)

Procedures:

Lecture:

Lecture
Demonstration

Laboratory:

Group work
Demonstration
Discussion

Learning Activities:

Lecture: Read Chapter 10

Laboratory: Start Lab 9

Evaluation:

Lecture: Quiz #4 (Chapters 9-10) (objective)

CST 2408: Data Communications and Networking

INSTRUCTOR'S GUIDE

Unit 11

Unit Title: Installation

Contents of Unit:

1. The Installation Log
2. Cable Distribution
3. Planning Ahead
4. Cable Handling
5. Cable Connectors
6. Fire-Retardant Cable
7. Cable Testing
8. Fault Tolerance
9. Interference
10. Grounding

Unit Objectives: Upon completion of this unit, the student will be able to:

1. Describe the reasons an installation log is necessary.
2. List 4 methods of distributing cable, including modeling examples.
3. List 4 reasons planning ahead is necessary.
4. Name 3 problems associated with cable installation.
5. Describe types of cable, cable connectors, and grounding techniques.
6. Describe cable testing and tolerance levels.
7. List 6 sources of interference and include methods to overcome the problem.

Equipment and Materials Required:

Lecture:

Text
Student's Lecture Guide (Unit 11)

Laboratory:

Student's Laboratory Guide (Lab 9 continued)
See materials listed in Instructor's Guide--Unit 10

Procedures:

Lecture:

Lecture
Demonstration

Laboratory:

Group work
Demonstration
Discussion

Learning Activities:

Lecture: Read Chapter 11

Laboratory: Complete Lab 9

Evaluation:

Lecture: None

CST 2408: Data Communications and Networking

INSTRUCTOR'S GUIDE

Unit 12

Unit Title: Performance

Contents of Unit:

1. The Data Path
   a. Using Disk Caching To Speed Up Network Operation
   b. Improving Access Time by Organizing Files
2. Network Servers: How Many To Use?
   a. Solving Disk Channel Problems
   b. Avoiding Cable Bottlenecks
3. Conclusion

Unit Objectives: Upon completion of this unit, the student will be able to:

1. List 2 methods to increase performance.
2. Define and give an example of a hierarchical directory.
3. Describe the methods used to determine how many servers should be used.
4. Describe reasons for channel and cable bottlenecks.

Equipment and Materials Required:

Lecture:

Text
Student's Lecture Guide (12)

Laboratory:

Student's Laboratory Guide (Lab 10)
Networked PC lab
1 tape dirve system per group (4 students)
1 manual on tape drive per group

Procedures:

Lecture:

Lecture
Demonstration

Laboratory:

Group work
Demonstration
Discussion

Learning Activities:

Lecture: Read Chapter 12

Laboratory: Complete Lab 10

Evaluation:

Lecture: Test #3 (Chapters 9-12) (objective)

CST 2408: Data Communications and Networking

INSTRUCTOR'S GUIDE

Unit 13

Unit Title: Maintenance and Diagnostics

Contents of Unit:

1. Network Control Center
2. Local Area Network diagnostics
3. NetWare Diagnostics
4. Diagnostics in Hardware
5. The role of the Network Manager
6. Network Monitoring
7. Looking Ahead

Unit Objectives: Upon completion of the unit, the student will be able to:

1. Execute a network diagnostics program for the software.
2. Execute a network diagnostics program for the hardware.
3. Describe the role of the network manager.

Equipment and Materials Required:

Lecture:

Text
Student's Lecture Guide (Unit 13)

Laboratory:

Student's Laboratory Guide (Lab 11)
Networked PC lab
Maintenance programs
    Disk mechanic
    RAM test
    file clerk

Cleaning programs and material
    Disk cleaning system
    Hydrogen peroxide
    1 soft paintbrush or toothbrush for 3 students
    Small tool kit (for tightening etc.)

Procedures:

Lecture:

Lecture
Demonstration

Laboratory:

Individual and Group work
Demonstration
Discussion
Tour

Learning Activities:

Lecture: Read Chapter 13

Laboratory: Start Lab 11

Evaluation:

Lecture: None

CST 2408: Data Communications and Networking

INSTRUCTOR'S GUIDE

Unit 14

Unit Title: Internetting

Contents of Unit:

1. Internet Hardware
2. Remote Interconnection
3. Asynchronous Gateways and Modem Pools
4. X.25 for Wide Areas
5. X.25 Options
6. Conclusion

Unit Objectives: Upon completion of this unit, the student will be able to:

1. Produce an example of internetting.
2. List 3 reasons internetting is useful or necessary.
3. Describe the levels at which internetting can occur.
4. List 2 protocols used for remote interconnecting and describe when each should be used.

Equipment and Materials Required:

Lecture:

Text
Student's Lecture Guide (Unit 14)

Laboratory:

Student's Laboratory Guide (Lab 11 continued)
See materials listed in Instructor's Guide--Unit 13

Procedures:

Lecture:

Lecture
Demonstration

Laboratory:

Individual and Group work
Demonstration
Discussion
Tour

Learning Activities:

Lecture: Read Chapter 14

Laboratory: Complete Lab 11

Evaluation:

Lecture: Quiz #5 (Chapters 13-14) (objective)

CST 2408: Data Communications and Networking

INSTRUCTOR'S GUIDE

Unit 15

Unit Title: The Mainframe Connection

Contents of Unit:

1. Terminal Evaluation
2. How To Evaluate an Emulator
3. The Emulator on the Network
4. Mainframe Gateways: Alternatives to Terminal Emulation
5. PCs as Mainframe Workstations
6. Backup on the PC
7. Downtime Equals Loss

Unit Objectives: Upon completion of this unit, the student will be able to:

1. Describe 3 common pitfalls when networking microcomputers with mainframes.
2. Describe the methods used to evaluate emulators.
3. List and describe 2 mainframe gateways.
4. List the advantages and disadvantages of using a PC for backup procedures.

Equipment and Materials Required:

Lecture:

Text
Student's Lecture Guide (Unit 15)

Laboratory:

Student's Laboratory Guide (Lab 12)
Networked PC lab
WAN communication license
Modems for communication

Procedures:

Lecture:

Lecture

Laboratory:

Individual and Group work
Discussion

Learning Activities:

Lecture: Read Chapter 15

Laboratory: Start Lab 12

Evaluation:

Lecture: None (objective)

CST 2408: Data Communications and Networking

INSTRUCTOR'S GUIDE

Unit 16

Unit Title: Electronic Mail

Contents of Unit:

1. Defining Electronic Mail
2. Using Electronic Mail
3. Evaluating Electronic Mail
4. An Intraoffice Study
5. Interoffice Mail

Unit Objectives: Upon completion of this unit, the student will be able to:

1. Define electronic mail.
2. List the components in electronic mail packages.
3. Evaluate electronic mail packages for capabilities and efficiency.
4. Describe the difference between interoffice and intraoffice mail.

Equipment and Materials Required:

Lecture:

Text
Student's Lecture Guide (Unit 16)

Laboratory:

Student's Laboratory Guide (Lab 12 continued)
See materials listed in Instructor's Guide--Unit 15

Procedures:

Lecture:

Lecture

Laboratory:

Individual and Group work
Demonstration
Discussion

Learning Activities:

Lecture: Read Chapter 16

Laboratory: Complete Lab 12

Evaluation:

Lecture: None (objective)

Final Evaluation (WEEK 17 FINAL EXAMS)

Lecture: Final Exam (50% from Chapters 1-12 and
50% from Chapters 13-16)

Laboratory: Final Exam